Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Mitigation of Orbital Debris in the New Space Age	)	IB Docket No. 18-313

COMMENTS OF WORLDVU SATELLITES LIMITED

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SUMMARY

OneWeb welcomes the Commission's efforts to join with industry and the many other interested parties, public and private alike, to update the U.S. regulatory framework for orbital debris. OneWeb agrees the time has come to account for the momentous changes in satellite technologies and architectures that have occurred over the last twenty years. At present, OneWeb takes no definitive position on whether the Commission should maintain jurisdiction over the orbital debris issues related to commercial communications satellites per se. While the Commission has done a remarkable job in managing the challenges of addressing orbital debris issues related to commercial communications satellites for the past fifteen years, the discussion—and resolution—of these complex issues must involve many more stakeholders and government bodies, both domestic and international.

No matter which agency or department of the U.S. government ultimately ends up with primary jurisdiction over orbital debris (one or more of the foregoing, the "Responsible Agency"), there will, at a minimum, be a transition period even if jurisdiction is moved from the Commission to another Responsible Agency. For this reason, the Commission will continue to play a critical role in managing and addressing orbital debris issues related to commercial communications satellites for at least the near future. Irrespective of whether the Commission remains the Responsible Agency, all satellite industry stakeholders have a duty to each other and to the global industry to address the substantive issues raised by the Commission throughout the NPRM. OneWeb is pleased to do so and thanks the Commission for demonstrating leadership by initiating this proceeding.

OneWeb is at the forefront of the rapid innovation and development that is transforming the global market for satellite-based services. OneWeb has accomplished many "firsts" over the last seven years: designing a cost effective constellation to help bridge the digital divide, initiating

the current Ku-band and Ka-band NGSO processing round, assembling an industry-leading group of strategic partners and investors committing billions of dollars in capital, establishing a state-of-the-art factory to mass-produce spacecraft in Exploration Park, Florida, building an end-to-end supply chain, and launching its first six production satellites in February 2019 to thoroughly validate its production processes prior to launching at scale in the coming months. OneWeb has achieved these milestones while simultaneously maintaining its focus on a foundational principal: space is a shared, natural resource and must be protected.

OneWeb has designed its constellation and is building its network consistent with this core philosophy. Commercial development of space cannot be achieved without responsible stewardship of the orbital environment. The NPRM recognizes that the recent acceleration of commercial space activities is challenging the regulatory framework in the United States. In response to the proposals in the NPRM, OneWeb suggests the following actions are necessary to update the orbital debris framework in the United States:

- **Adopt a Thoughtful Regime That Is Well-Integrated Into the Broader Regulatory Framework In the United States.** As both spectrum and debris regulator for non-federal satellite communications networks, the Commission occupies a unique role in the larger regulatory framework in the United States. As the authority of other federal agencies and regulatory bodies over space-based operations expands (or contracts), the Commission should rationalize its rules to ensure the obligations of satellite operators are clear and the Commission's jurisdictional boundaries are well defined.

- **Mandate Adequate Orbital Separation Between Large NGSO Constellations**. Common sense dictates that collocating multiple large NGSO constellations in overlapping operational altitudes is a recipe for orbital catastrophe. As the number of satellites expected to populate LEO continues to increase, the Responsible Agency—consistent with international standards and prevailing industry best practices—should consider mandating adequate orbital separation between large NGSO constellations.

- **Deter and Disincentivize "Test in Space" Architectures That Increase the Risk of Debris Generation.** Simply put, space safety starts on the ground. There is growing industry consensus that spacecraft and component part reliability must be

rigorously established on the ground before ever being attached to a launch vehicle. The Responsible Agency should adopt a ground testing requirement to ensure that "iterate in space" designs for spacecraft do not endanger the orbital environment.

- **Require All Satellite Operators To Track and Control Their Spacecraft**. All satellite operators have a fundamental responsibility to track and control the trajectory of their in-orbit assets and to share this information with other stakeholders. Instead of merely requiring operators to specify particular on-orbit capabilities, the Responsible Agency should require that all spacecraft operating above the ISS include maneuverability capability in addition to trackability.

- **Assess Casualty and Collision Risk on an Aggregate Basis**. With the advent of NGSO constellations consisting of hundreds and even thousands of satellites, it is no longer sufficient to assess collision and casualty risk on a per-spacecraft basis alone. The Responsible Agency should also require large NGSO constellations to calculate collision and casualty risk on an aggregate basis, thus presenting a more accurate portrayal of the potential harm to the orbital environment and human populations.

- **Reduce the Amount of Time Non-Functional Satellites Remain In-Orbit.** Currently, satellites are permitted to remain in-orbit for 25 years after decommissioning regardless of their useful operational life. This is unnecessary and poses an unacceptable risk to future missions. The Responsible Agency should adopt a .95 de-orbit reliability standard and require that post-mission lifetimes not exceed their operational lifetimes by more than a factor of two, up to a maximum of five years.

- **Recognize Limited Authority Over U.S. Market Access Applicants**. The Commission lacks a clear jurisdictional basis to impose indemnification or insurance obligations on market access applicants, many of whom already provide such commitments to their launching states. The Commission should also continue to allow market access applicants to satisfy orbital debris mitigation requirements by demonstrating direct and effective regulation by their national licensing authorities.

OneWeb is optimistic that adoption of the foregoing proposals will modernize the debris and space safety framework in the United States while simultaneously fostering continued growth and innovation in space.

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COMMENTS OF WORLDVU SATELLITES LIMITED

WorldVu Satellites Limited ("OneWeb") respectfully submits these comments in response to the Commission's notice of proposed rulemaking ("NPRM").[1]

I. THE COMMISSION SHOULD COORDINATE ITS ORBITAL DEBRIS REGULATION EFFORTS WITH OTHER FEDERAL AGENCIES AS THE REGULATORY FRAMEWORK IN THE UNITED STATES CONTINUES TO EVOLVE

In the NPRM, the Commission revisits its discussion from the 2004 Orbital Debris Order regarding the jurisdictional basis and legal authority for the Commission to propagate orbital debris rules and calls for further comment on the issue.[2] As a U.K.-based satellite operator, OneWeb is subject to the regulation and oversight of the United Kingdom Space Agency ("UKSA"). However, as the catalyst for the Commission's initiation of the current processing rounds to consider applications for non-geostationary, fixed-satellite service ("NGSO FSS") systems, OneWeb has collaborated with key U.S. stakeholders regarding orbital debris and space safety. OneWeb's founder and executive chairman, Greg Wyler, testified before the U.S. Senate regarding the need for new orbital debris and space safety regulations in the United States.[3] No other NGSO operator has advocated as consistently or as tirelessly as OneWeb regarding the acute need for a modern orbital debris regulatory framework in the United States and internationally.

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[1] *Mitigation of Orbital Debris in the New Space Age, et al.*, Notice of Proposed Rulemaking and Order on Reconsideration, IB Dkt. No. 18-313, FCC 18-159 (rel. Nov. 19, 2018) ("NPRM").

[2] NPRM at ¶ 15. *See also Mitigation of Orbital Debris*, Second Report and Order, 19 FCC Rcd 11567, 11574 ¶ 12 (2004) ("2004 Orbital Debris Order").

[3] *See The Commercial Satellite Industry: What's Up and What's on the Horizon Before the S. Comm. on Commerce, Science and Technology*, 115th Cong. 2 (2017) (statement of Greg Wyler, Founder and Executive Chairman, OneWeb) ("Senate Testimony").

As the Commission considers the nature and scope of its role with respect to orbital debris issues, OneWeb encourages the Commission to ensure this proceeding contributes to a regulatory framework that gives due consideration to the subject matter expertise and resources possessed by other federal agencies and expert regulatory bodies. OneWeb emphasizes that adopting easily discernible rules, providing continued transparency to industry, consistently and even-handedly enforcing applicable standards, and carefully observing clear jurisdictional and statutory limits remain the essential qualities of effective agency regulation.

Conversely, the adoption of overlapping or inconsistent regulations that unintentionally result in a patchwork regulatory regime for orbital debris could stall the otherwise surging growth of NGSO FSS systems. Regulatory uncertainty and unpredictable policymaking—the hallmarks of ineffective agency action—could effectively disincentivize the introduction of innovative NGSO-based technologies into the U.S. market. In light of recent predictions that space commerce could be a trillion-dollar industry by 2040,[4] this is an outcome the Commission should strive to avoid. OneWeb agrees with the Commission that a "coordinated, effective regulatory environment" is essential to the health of the satellite industry, and remains eager to contribute towards the modernization of the orbital debris framework in the United States.[5]

II. THE UPDATED ORBITAL DEBRIS FRAMEWORK SHOULD MANDATE ADEQUATE ORBITAL SPACING BETWEEN LARGE CONSTELLATIONS

The NPRM proposes to adopt rules addressing the risks pertaining to various sources of in-orbit collisions, including requirements relating to orbital selection and the quantification of

[4] *See* Jeff Foust, *A trillion-dollar space industry will require new markets*, SPACENEWS (Jul. 5, 2018), https://spacenews.com/a-trillion-dollar-space-industry-will-require-new-markets/.

[5] NPRM at ¶ 14.

collision potential.[6] The Commission apparently fails to encourage—or even consider—a well-established technique to reduce the potential for debris-generating events posed by the deployment of more than one large NGSO FSS constellation: adequate orbital separation of such constellations. As discussed in detail below, requiring adequate orbital separation is consistent with current Inter-Agency Space Debris Coordination Committee ("IADC") guidance, and the Commission has recognized the value of preventing overlapping orbits in the past. The Commission does propose to require satellite operators to identify the collision risks posed by specific satellites in nearby orbits, which represents a positive first step toward ensuring orbital separation.

A. The Commission Should Not License or Grant U.S. Market Access to Large NGSO Constellations With Overlapping Orbits

OneWeb commends the Commission for recognizing the magnitude of the potential problems posed by orbital debris.[7] The Responsible Agency should adopt rules that both adequately protect in-orbit spacecraft and decrease the occurrence of debris-generating events in space. To effectively incentivize orbital architectures that promote safe operation and deter collision-causing events, the merits of adequate inter-constellation spacing should be considered and codified. The advent of large-scale NGSO FSS constellations will result in a significant increase in the number of satellites in orbit. As Commissioner Carr has noted, "[o]ne company alone plans to launch more than 10,000 satellites."[8] Northern Sky Research has also stated that

[6] *Id*. at ¶¶ 25-35.

[7] *Id*. at ¶¶ 2, 8.

[8] *Id*. at 61.

such constellations "lead to a higher risk of collision – either with each other or with existing debris in orbit, which further lead to more debris, also known as Kessler Syndrome."[9]

While in-orbit failures can be minimized, they cannot be eliminated altogether and are a contingency for which every satellite operator must prepare. Such failures may become a danger to nearby space objects. To manage this risk, operators should be required to maintain adequate orbital separation between constellations such that these inevitable spacecraft failures do not create unnecessary conjunction management burdens for another operator, or worse, result in catastrophic events between two non-maneuverable objects. As OneWeb and multiple other satellite operators have cautioned, a failure to maintain adequate inter-constellation separation "elevates the risk of collision."[10] Moreover, OneWeb and other operators have already put this principle into action: in 2016 and 2017, OneWeb successfully negotiated with Boeing to deconflict the operational orbits of the two constellations.[11]

These practices are consistent with recent guidance from the IADC, an international governmental forum made up of representatives from thirteen spacefaring nations.[12] In 2017 the

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[9] Shagun Sachdeva, *The Unintended Consequences of Smallsats*, NORTHERN SKY RESEARCH (Apr. 3, 2019), https://www.nsr.com/the-unintended-consequences-of-smallsats/?utm_source=Satellite+and+all+NSR+News&utm_campaign=bea54e3a06-EMAIL_CAMPAIGN_2018_07_17_04_46_COPY_01&utm_medium=email&utm_term=0_ff2c5c9f7f-bea54e3a06-259502849.

[10] Timothy Maclay, Walt Everetts and Doug Engelhardt, *Responsible satellite operations in the era of large constellations*, SPACENEWS (Jan. 23, 2019) ("Orbital Debris Op-Ed").

[11] *See* Letter from Brian D. Weimer and Bruce A. Olcott, Counsel to WorldVu Satellites Limited and The Boeing Company, to Marlene H. Dortch, Secretary, FCC, IBFS File Nos. SAT-LOI-20160428-00041, SAT-LOA-20160622-00058, and SAT-AMD-20170301-00030 (Mar. 23, 2017).

[12] *See* IADC Space Debris Mitigation Guidelines, IADC, IADC-02-01, Rev. 1 (2007) ("IADC Guidelines").

IADC, rightly concerned about the orbital debris consequences of the proliferation of NGSO FSS constellations in LEO, issued a Statement on Large Constellations of Satellites in Low Earth Orbit, which outlines recommendations on how to mitigate the orbital debris impact of such constellations.[13] The IADC Statement explicitly recommends consideration of "sufficient altitude separation…with respect to other large constellations and crowded orbits in order to minimise the potential collision risk."[14] The recommendations contained in the IADC Statement were drafted to provide satellite operators and licensing authorities with technical guidance as to how best to comply with the IADC Guidelines.[15] Given the explicit recommendation by the IADC and the role adequate orbital separation plays in adhering to IADC guidelines, adequate orbital separation is increasingly recognized as an essential element of effective orbital debris mitigation.

The Commission is no stranger to the role orbital separation plays in furthering debris mitigation efforts. In the 2004 Orbital Debris Order, the Commission observed that in "heavily used orbits…additional measures may be warranted to avoid collision, such as…assignment of orbital locations designed to ensure adequate physical separation between operational satellites."[16] The Commission also required entities seeking approval for LEO operations to address measures undertaken to ensure a minimum distance separation from inhabitable orbiting objects, displaying a recognition of the role of physical separation in preventing collisions.[17] Similarly, the

[13] IADC Statement on Large Constellations of Satellites in Low Earth Orbit, IADC, IADC-15-03 (2017) ("IADC Statement").

[14] *Id.* at 7.

[15] *Id*. at 6-7.

[16] *See* 2004 Orbital Debris Order at ¶ 34.

[17] *See id*. at ¶ 56.

Commission's two-degree orbital spacing requirement for GSO satellites demonstrates the Commission's willingness to require separation between satellites.[18] While exclusive use of orbital slots is granted to GSO satellite operators to avoid RF interference, and separation is ensured via mean anomaly assignments (longitudinal slots), the Commission nonetheless has demonstrated a long-standing willingness to grant exclusive use to particular orbits for safety and mission assurance reasons.

The Commission has so far failed to specify a minimum orbital separation between NGSO FSS constellations, yet it has clearly considered the risks of orbital overlap and is cognizant of the benefits of physical separation between objects in space. It has even established precedence for authorizing preferential use of certain orbital slots (albeit for reasons of RF interference rather than physical interference). OneWeb respectfully suggests that all of LEO may soon become precisely the kind of "heavily used orbit" the Commission anticipated would justify a requirement for adequate physical spacing.

If properly planned and spaced, there is currently "plenty of room in LEO for many constellations," and no compelling reason for approval of large constellations in overlapping orbits.[19] Proper planning and spacing of large NGSO constellations would achieve adequate physical separation without instituting a maximum limit for variances in orbital parameters for NGSO systems, which could limit operators' flexibility to adapt to changing mission requirements.[20] To adopt significant changes to the orbital debris regime in this proceeding

[18] *See Comprehensive Review of Licensing and Operating Rules for Satellite Services*, Second Report and Order, 30 FCC Rcd 14713, 14750 at ¶ 103 (2015) (retaining the Commission's long-standing two-degree orbital separation policy for GSO satellites).

[19] Orbital Debris Op-Ed.

[20] NPRM at ¶ 35.

without ensuring adequate orbital separation between constellations would not only ignore a best practice already recognized by operators and international experts; it would also unnecessarily jeopardize the continued safety of the LEO environment. OneWeb restates its request that NGSO operators not be licensed, authorized, or allowed to deploy large constellations in overlapping orbits.

B. Operators Should Be Required to Identify Collision Risks With Other NGSO Spacecraft at Nearby Operational Altitudes

OneWeb supports the proposal in the NPRM to revise the existing rule regarding collision risk by requiring the orbital debris mitigation plan of a LEO satellite to include an analysis of potential risk of collision, disclosures regarding whether a satellite operator is relying on coordination with the other system for collision avoidance, and what coordination measures have been or will be taken.[21] The NPRM also proposes to revise the wording of the rule to require the orbital debris mitigation statement to identify the planned and/or operational satellites to which the applicant's satellite poses a collision risk, and indicate what steps will be taken to coordinate and avoid collision.[22]

OneWeb supports the proposed revisions to encourage the development of a safer orbital environment by requiring a more precise analysis of potential collision risks. Along those lines, OneWeb's support also extends to the proposal to apply this rule to all NGSO satellites, not just those in LEO. Such a rule would make clear that orbital stewardship is a shared responsibility of all operators. The Commission additionally asserts that collision risk "may be best addressed in the first instance through inter-operator coordination."[23] OneWeb agrees with the Commission

[21] *Id*. at ¶ 28.

[22] *Id*.

[23] *Id*.

and notes that such inter-operator coordination should supplement a requirement for large NGSO FSS systems to maintain adequate orbital separation from one another.

III. DESIGN RELIABILITY SHOULD BE A CRITICAL COMPONENT OF ANY EFFECTIVE ORBITAL DEBRIS MANAGEMENT REGIME

Any updates to the orbital debris regime in the United States should recognize that responsible orbital stewardship begins on the ground. In particular, the Responsible Agency should ensure that any space object subject to its jurisdiction intended for operation above habitable space stations has been appropriately qualified on the ground, and that satellites of a new design should be launched in limited numbers until on-orbit performance is verified. Further, if satellite failures do occur during the deployment of a constellation, root cause(s) should be identified and corrected on the ground before additional satellites are launched. The Responsible Agency should fundamentally reject the "iteration in space" concept and should not allow untested and immature spacecraft designs to put other operators' assets in jeopardy.

A. A Ground Qualification Analysis Is Necessary to Ensure Spacecraft Design Reliability

In the NPRM, the Commission rightly concludes that spacecraft design or reliability flaws "could result in a significant number of non-functional spacecraft in an operational orbit, contributing to the orbital debris population."[24] To address this risk, the Commission seeks "comment on whether it would be appropriate to impose a design and fabrication reliability requirement" and proposes a potential .999 per spacecraft metric for a constellation including a "large number of satellites" or that will be "deployed at higher altitudes in LEO."[25] The Commission notes it considers "deployment of 100 satellites over a typical 15-year license term

[24] *Id*. at ¶ 42.

[25] *Id.* at ¶ 43.

to be a deployment of a large number of satellites" and characterizes "higher altitudes" as those "with a perigee above 600-650 km."[26] OneWeb agrees that design and reliability flaws are a serious safety issue and should be addressed prior to launch. However, the .999 metric should not be adopted, as this threshold is both unnecessarily and impractically stringent. Instead, OneWeb suggests the adoption of a rule requiring a design reliability of 0.95, coupled with rigorous pre-launch testing for any satellite intended for operation above the International Space Station ("ISS").

As an initial matter, OneWeb notes that a reliability metric of 0.999 - based on a suggestion from the National Aeronautics and Space Administration ("NASA") – is overly prescriptive and would be cost-prohibitive for many commercial programs. Additionally, design and manufacturing flaws are not captured in traditional reliability analyses, so any design reliability metric must be paired with rigorous, ground-based environmental acceptance testing standards to prevent "dead on arrival" spacecraft from becoming potential sources of orbital debris.

To not require some kind of ground qualification testing would effectively create a loophole in any new orbital debris regime that jeopardizes the orbital environment by allowing operators to launch satellites containing questionable, low-cost component parts that unnecessarily increase the likelihood of an in-orbit failure and generation of orbital debris.

B. The Ground Qualification Rules Should Provide Exceptions For Small Numbers Of Satellites And Satellites Launched to Very Low Orbits

OneWeb recognizes there are certain circumstances in which the Commission could allow the launch of satellites that have not completed a full ground qualification and testing campaign. For example, OneWeb notes that universities and research institutions frequently launch experimental spacecraft where thorough ground testing would be impractical and prohibitively

[26] *Id.*

expensive.[27] To promote technological innovation and education, there should be exceptions to ground qualification requirements for individual experimental or educational spacecraft. Furthermore, such requirements could be waived for any number of satellites intended for operation below the ISS, as satellites failing below this altitude will not remain in orbit for long periods of time and therefore pose little risk to other operators and have little impact on the environment.

C. Constellation Operators Must Be Particularly Careful In Their Deployment of Large Numbers of Spacecraft

A key risk of any new satellite development program is that undetected design or manufacturing problems could lead to premature failure in orbit. As NASA has remarked, a "design or fabrication flaw can potentially lead to malfunction or even explosion of many spacecraft during the deployment or mission operations of the constellation."[28] Low-cost programs designing satellites with short lifetimes and shortened test campaigns are "particularly vulnerable to this type of failure."[29] Constellation operators must take special care to prevent the deployment of large numbers of satellites carrying a systemic flaw.[30] Therefore, satellites of a new design should be launched initially in small numbers until their on-orbit performance can be verified, and in the event that satellite failures are evident in early deployments, the problem must

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[27] *See, e.g.* Daniel Strain, *Small satellites tackle big scientific questions*, CU BOULDER TODAY (Nov. 15, 2018), https://www.colorado.edu/today/2018/11/15/small-satellites-tackle-big-scientific-questions.

[28] Sue Aleman, *Small Spacecraft Reliability Knowledge Sharing: OSMA Perspective*, NASA at 2 (Oct. 11, 2017), https://www.nasa.gov/sites/default/files/atoms/files/sue_aleman-_small_satellite_reliability-osma_perspective.pdf.

[29] Orbital Debris Op-Ed.

[30] *Id*.

be understood and satellites yet to be launched must be repaired before continuing with a launch campaign.

IV. SATELLITE OPERATORS MUST MAINTAIN CONTROL OF THE TRAJECTORY OF THEIR SPACE ASSETS

A simple yet fundamental responsibility of every satellite operator is the ability to track and control the trajectories of their assets. Orbital debris regulations should reflect this common-sense principle. *All* spacecraft must be trackable and any spacecraft deployed above the ISS should include maneuvering capabilities in order to obtain a license or U.S. market access from the Commission.

A. The Proposed Requirement to Specify Operational Constraints Imposed on the ISS Is Important for the Safety of the ISS

The NPRM proposes to require NGSO applicants who may traverse or operate in orbits near the ISS to disclose any operational constraints its mission imposes on the ISS.[31] Inhabitable spacecraft should be afforded special protections, given the risk to human life posed by a collision and the expense and operational disruption involved with maneuvering the ISS. The recent "near-miss" incident involving the Denali satellite in a nearby area of LEO illustrates the orbital debris threats posed to the ISS, which are compounded by the ISS' limited maneuverability. [32]

B. Operators Should Be Required to Track Their Satellites and Share Position Data With Other Operators

OneWeb agrees with the statement in the NPRM "that improvements in the ability to track and identify satellites in NGSO may help to reduce the risk of collisions."[33] Every satellite

[31] NPRM at ¶ 30.

[32] Payam Banazadeh, *Denali's Near Miss and the Growing Problem of Space Debris*, CAPELLA SPACE (Feb. 11, 2019), https://www.capellaspace.com/denalis-near-miss-and-the-growing-problem-of-space-debris/.

[33] NPRM at ¶ 36.

operator has the responsibility to know where its spacecraft are, predict and control their trajectories, state the means by which it will accomplish these tasks, and share relevant information with other operators.

OneWeb generally agrees with the proposals in the NPRM to mandate the disclosure and sharing of certain position and maneuvering information from NGSO operators, including "a statement from the applicant regarding the ability to track the proposed satellites using space situational awareness facilities," disclosing whether satellite tracking will be active or passive, sharing ephemeris data with operators or other systems operating in the same region of space, and providing relevant information to the 18th Space Control Squadron.[34] OneWeb further agrees that operators of spacecraft of any dimension less than 10 cm should provide additional information concerning trackability.[35] Such a rule would help address the considerable threat posed by lethal non-trackable debris ("LNT Debris"). OneWeb notes that some studies estimate LNT Debris constitutes 95% or more of the current debris in LEO.[36] Updated orbital debris mitigation regulations should reflect this operational reality and provide strong incentives for operators to ensure their space assets remain trackable at all times.

The NPRM also proposes that NGSO applicants "take all possible steps to assess and, if necessary, to mitigate collision risk" upon receiving a conjunction warning, including the sharing of ephemeris and other appropriate operational data.[37] OneWeb agrees with the proposal and has

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[34] *Id*. at ¶¶ 36-37, 73.

[35] *Id*. at ¶ 36.

[36] *See, e.g.* Darren McKnight, Kris Walbert, *Proposed Series of Orbital Debris Remediation Activities*, INTEGRITY APPLICATIONS at 2 (2011) ("the cataloged population…evaded through active maneuvering is less than 5% of the lethal population").

[37] NPRM at ¶ 38.

previously stated its intentions to openly share this kind of data with other operators.[38] The open sharing of relevant positional information is precisely the kind of best practice that should be encouraged.

Consistent with this emphasis on requiring best practices in space, the NPRM also seeks comment on requiring an NGSO applicant to describe the extent of its maneuverability capabilities throughout its mission, including any end-of-life disposal phase.[39] The NPRM further calls for comment specifically on the "effectiveness and suitability" of differential drag or other maneuvering techniques "under real world conditions."[40] OneWeb agrees with these proposals and suggests the maneuverability disclosure requirement acknowledge that collision avoidance efficacy is a function of orbital agility. As such, the disclosure should include information detailing the satellite's maneuvering capabilities, including achievable conjunction separation distances based upon decision lead time and the process by which an applicant intends to assess conjunctions and execute required evasive maneuvers. Such disclosures would allow operators who do not maintain on-board propulsion techniques to operate in higher LEO orbits while also providing assurance to other operators that constellations relying on differential drag will not pose a risk to the LEO environment.

[38] *See* Caleb Henry, *OneWeb vouches for high reliability of its deorbit system*, SPACENEWS (Jul. 10, 2017), https://spacenews.com/oneweb-vouches-for-high-reliability-of-its-deorbit-system/ ("OneWeb De-Orbit Article").

[39] NPRM at ¶ 39.

[40] *Id*.

C. All Space Stations Deployed Above the ISS Should Be Required to Demonstrate the Capability to Undertake Collision Avoidance Maneuvers

The NPRM seeks comment on requiring "all NGSO satellites planning to operate above a particular altitude to include propulsion capabilities."[41] OneWeb urges the adoption of a slightly more general requirement that all licensed operators demonstrate an ability to control the trajectories of their spacecraft and the capability to execute timely and effective collision avoidance maneuvers. This requirement should extend to *all* satellite operators proposing to operate satellites above the ISS, or approximately 400 km.

As space commerce above 400 km altitude has accelerated in recent years, there has been a corresponding focus on increasing Space Situational Awareness ("SSA") and Space Traffic Management ("STM") capabilities.[42] OneWeb has been an industry leader on this issue, repeatedly highlighting the need for operators to maintain custody and control of their space assets at all times.[43] By maintaining control of their spacecraft, operators not only contribute to their own mission assurance and reduce the likelihood of becoming a source of debris, they also facilitate the ability of other operators to do the same. Absent regulation mandating that satellite operators maintain control of their spacecraft in what will surely become a more crowded LEO environment, a debris-generating collision above the ISS will remain a real—but preventable—threat.

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[41] *Id*. at ¶ 34.

[42] *See* Glenn Peterson, Marlon Sorge, and William Ailor, *Space Traffic Management in the Age of New Space*, The Aerospace Corporation (Apr. 2018), https://aerospace.org/sites/default/files/2018-05/SpaceTrafficMgmt_0.pdf.

[43] *See* Orbital Debris Op-Ed.

OneWeb emphasizes it does not support a requirement for all operators to include a traditional propulsion system on their spacecraft. Instead, operators should confirm the *maneuverability* of their spacecraft during the licensing process. For example, many small satellite operators have touted an ability to rely on differential drag techniques to conduct collision avoidance maneuvers.[44] Although these techniques merit closer scrutiny, OneWeb does not oppose licensing of spacecraft utilizing differential drag or similar mechanisms if operators can demonstrate that their reliance on these techniques facilitates timely collision avoidance capabilities.[45] Such a regime would provide operators with appropriate mission flexibility to operate at a range of altitudes without otherwise compromising the operations of other nearby operators or the orbital environment itself.

V. CASUALTY AND COLLISION RISK ANALYSES SHOULD BE ASSESSED ON A SYSTEM-WIDE BASIS

Current rules only require applicants to describe the in-orbit collision and human casualty risks on a per-satellite basis.[46] These rules were adopted prior to any proposals for NGSO systems with hundreds or thousands of satellites. In order to account for the potential danger to the orbital environment, other operators, and human life posed by such constellations, any Responsible Agency should act to require quantification of the aggregate risks these systems present.

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[44] *See, e.g. Spacecrafts' solar panels can service double-duty as sails*, THE ECONOMIST (Mar. 7th, 2019), https://www.economist.com/science-and-technology/2019/03/09/spacecrafts-solar-panels-can-serve-double-duty-as-sails (noting Planet "now flies 120 Earth-imaging satellites which manoeuvre solely by differential drag" and Spire's 72 satellites in orbit "manoeuvre exclusively by differential drag").

[45] *See Streamlining Licensing Procedures for Small Satellites, Notice of Proposed Rulemaking,* IB Docket No. 18-86, FCC 18-44, ¶ 34 (2018).

[46] *See* 47 C.F.R. §§ 25.114(d)(14)(iii)-(iv).

A. The Current NASA Standard For Quantifying Collision Risk on a Per-Spacecraft Basis Should Be Paired With a Corresponding System-Wide Limit

The NPRM proposes to incorporate the current NASA standard for quantifying collision risk with large objects (the "NASA Standard").[47] OneWeb generally agrees with these proposals but urges the application of the collision risk metric on an aggregate, system-wide basis.

OneWeb supports the NPRM's proposal to require NGSO applicants to demonstrate compliance with the NASA Standard. Quantification of this collision risk will allow regulators and other NGSO operators to better assess the orbital implications of an NGSO constellation. However, the proposal to consider a spacecraft with maneuverability to have a risk of "zero or near zero" oversimplifies the importance of maneuverability and should not be adopted.

Collision risk is dependent on more characteristics than the ability to maneuver. For example, the Iridium 33 spacecraft included on-board propulsion when it crashed with the Cosmos 2251 spacecraft.[48] Other factors must be considered, including the accuracy with which an applicant intends to maintain current and projected positional knowledge, whether this information and maneuvering plans will be made available to data aggregators and other operators, and the effectiveness of the applicant's maneuvering capabilities. Thus, a determination that collision risk is "zero or near zero" requires a more holistic approach.

Critically, in addition to applying the NASA Standard on a per-satellite basis, risk must also be evaluated on an aggregate, system-wide basis. OneWeb observes that the licensing of

[47] NPRM at ¶ 26. The current NASA Standard requires operators to demonstrate that the probability that their spacecraft will collide with a large object during the orbital lifetime of the spacecraft will be no greater than 0.001.

[48] Brian Weeden, *2009 Iridium-Cosmos Collision Fact Sheet*, SECURE WORLD FOUNDATION (Nov. 10, 2010), https://swfound.org/media/6575/swf_iridium_cosmos_collision_fact_sheet_updated_2012.pdf (noting Iridium-33 was an LM700 model satellite).

NGSO constellations has increasingly and appropriately trended towards obtaining aggregate collision risk information even in the absence of an enforceable rule.[49] This practice should be formalized to ensure operators of large NGSO constellations have thoroughly demonstrated, prior to any licensing, that such constellations do not present an unacceptable collision risk.

The NPRM also seeks comment on the definition of a "large object" for purposes of determining collision risk.[50] The term "large object" should be linked to the consequences associated with a collision with such an object, which can range from no functional loss at all to catastrophic, structural fragmentation of the spacecraft. While the outcome depends on many factors, the Responsible Agency should consider the impact energy threshold of 40J/g that NASA frequently cites as the amount of energy generally needed to break up a satellite. As such, OneWeb proposes that a "large object" be interpreted to mean an object with the potential to fragment an applicant's satellite: an event that has both mission and environmental consequences.

The NPRM also proposes to adopt the NASA Standard requiring operators to demonstrate the probability of accidental collision with small objects that would cause loss of control and prevent post-mission disposal of their spacecraft is less than 0.01. NASA echoes these concerns, noting the potential effects of small debris on large constellations in LEO.[51] OneWeb agrees that LNT Debris poses a real threat to mission assurance but recommends a more holistic approach that

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[49] *See, e.g.*, Letter from Jose P. Albuquerque, Chief, FCC Satellite Division, to Mike Safyan, Director of Launch and Regulatory, Planet Labs Inc., IBFS File No. SAT-MOD-20150802-00053 (Nov. 13, 2015) (requesting Planet Labs "provide information regarding the aggregate risk of accidental collision with catalogued space objects from the proposed satellite constellation").

[50] NPRM at ¶¶ 26-27.

[51] *See* J.-C. Liou, et. al., *NASA ODPO's Large Constellation Study*, ORBITAL DEBRIS QUARTERLY NEWS at 4-7 (Sep. 2018), https://www.orbitaldebris.jsc.nasa.gov/quarterly-news/pdfs/odqnv22i3.pdf ("NASA Large Constellation Study").

recognizes that small debris impacts represent only one contributor to the overall risk of being unable to de-orbit. Instead of simply applying the NASA standard, the adoption of a comprehensive deorbit reliability metric (accounting for all failure modes) would be more effective in the licensing of NGSO constellations.

Furthermore, as with large debris collision risk, OneWeb recommends applying the NASA Standard for small debris impacts on a per-satellite basis while also requiring an evaluation of the aggregated system. Additionally, these metrics should not be limited to operations in highly-populated orbits or large constellations.[52] The prevention of in-orbit collisions is the responsibility of all operators, not simply those proposing to operate in specific LEO orbits or with large constellations.

Finally, OneWeb agrees with the proposal to require satellite operators to identify planned or operational satellites to which the applicant's satellite poses a collision risk.[53] As described in Section II.A above, adequate orbital spacing between constellations is necessary to ensure safe orbital operations. OneWeb also agrees with the NPRM proposal to extend this requirement to all NGSO spacecraft, not just those operating or proposing to operate in LEO.[54]

B. The NASA Standard For Per-Satellite Re-Entry Casualty Risk Must Be Used in Conjunction With a System-Wide Casualty Risk Assessment

Consistent with the proposal to rely on the NASA Standard to assess collision risk, the NPRM proposes to require applicants to include all objects in a casualty risk assessment with an impacting kinetic energy in excess of 15 joules.[55] The NPRM also proposes to require applicants

[52] NPRM at ¶ 27.

[53] *Id*. at ¶ 28.

[54] *Id*.

[55] *Id*. at ¶ 61.

to provide statements indicating the actual calculated human casualty risk when the calculated risk is greater than zero and invites comments on the necessity of calculating these figures on an aggregate, system-wide basis.[56]

OneWeb agrees it would be appropriate to apply the NASA Standard for per-spacecraft reentry risk (using the 15 joule kinetic threshold) and suggests the extension of this concept by requiring such analysis to be conducted on an aggregate, system-wide basis. When potentially thousands of spacecraft are being de-orbited through uncontrolled re-entry, it is vitally important that regulators and other key stakeholders are able to adequately review and assess the probability of injury to human populations from the hundreds of thousands of spacecraft components that may reach the Earth's surface. However, because large constellations will require spare and replenishment satellites on an ongoing basis, determining the number of satellites to include in an aggregate evaluation is open to interpretation. OneWeb therefore suggests that such evaluations are expressed as an annualized rate rather than a singular, total system risk.

Tellingly, many satellite industry stakeholders and observers have already expressed concerns regarding the looming danger presented by some large NGSO constellations.[57] The potential for large NGSO constellations to cause injuries has also not escaped the Commission's notice; on multiple occasions, the Commission has identified NGSO FSS applicants whose aggregate, system-wide casualty risks present troubling profiles.[58] For example, IEEE Spectrum

[56] *Id*. at ¶ 62.

[57] *See*, *e.g.* Orbital Debris Op-Ed.

[58] *See* Letter from Jose P. Albuquerque, Chief, Satellite Division, to William M. Wiltshire and Paul Caritj, Counsel to SpaceX, IBFS File No. SAT-MOD-20181108-00083 (Feb. 26, 2019); Letter from Jose P. Albuquerque, Chief, Satellite Division, to Tom W. Davidson, Counsel to Theia, IBFS File No. SAT0LOA-20161115-00121 (Mar. 15, 2017).

recently calculated the aggregate risk from SpaceX's initial proposed constellation and determined that "the overall risk of debris from the constellation causing an injury or death will be 45 percent. This means that NASA's software says it is nearly as likely than not that Starlink satellites will injure or kill someone every six years."[59] The fact that the actual risk of SpaceX's initial proposed constellation—as portrayed by its aggregate casualty risk—was presented in an online media piece instead of included in SpaceX's multiple space station license applications underscores the need for the *requirement* of this kind of information from applicants.

Other operators have also joined OneWeb's advocacy on this point, pointing out that larger constellations "can cause substantially more damage over extended periods of time" and "should be held to tighter requirements, and their operators should evaluate re-entry casualty risk on a system-wide, annual basis."[60] Thus, there appears to be growing agreement that an aggregate, system-wide analysis is the appropriate metric for evaluating casualty risk. OneWeb reiterates its request that applicants provide such an assessment as part of their license applications.

VI. AN IMPROVED FRAMEWORK FOR THE SUCCESSFUL DE-ORBIT OF SATELLITES IS NECESSARY TO PROTECT THE ORBITAL ENVIRONMENT

OneWeb agrees that changes are needed to the existing de-orbit guidelines. However, the de-orbit proposals in the NPRM generally miss the mark. The NPRM's proposal to require operators above the 650 km altitude to justify their orbit selection is cumbersome and unnecessary. Similarly, the NPRM's proposal for a "staging" orbit requirement below 650 km could thwart the strong momentum behind the development of NGSO FSS systems. Requiring automatic de-

[59] Mark Harris, *Here Are the Odds That One of SpaceX's Internet Satellites Will Hit Someone*, IEEE SPECTRUM (Dec. 17, 2018, 12:08 PM), https://spectrum.ieee.org/tech-talk/aerospace/satellites/the-odds-that-one-of-spacexs-internet-satellites-will-hit-someone.

[60] Orbital Debris Op-Ed.

orbiting of certain non-operational satellites may even increase collision risks. The NPRM is right to encourage active de-orbiting but the Responsible Agency should refrain from specifying a particular method of doing so. OneWeb also urges adoption of a .95 reliability standard for de-orbit operations.

A. De-Orbit Period Requirements Should Be Tied to Mission Duration

The NPRM proposes to require operators above an altitude of 650 km to describe their rationale for choosing this altitude and describe the relevant characteristics, even if the proposed spacecraft contain propulsive capabilities.[61] This proposal rests on two incorrect assumptions: (i) that 25 years is an appropriate limit on post-mission orbital lifetime, and (ii) that 650 km is the appropriate altitude to correlate with a natural 25-year disposal.[62] Both of these assumptions are flawed and the NPRM's proposal should be rejected.

First, the Commission notes as a basis for the 25-year post-mission orbital lifetime standard the 2004 Orbital Debris Order, which relied on U.S. Government Orbital Debris Standard Practices.[63] As the Commission recognizes, the LEO environment at that time was drastically different. In 2004, there were no commercial NGSO FSS constellations and the number of small satellites in-orbit was significantly smaller.[64] While this regime might have made sense fifteen years ago, it should no longer be permissible for a spacecraft to remain in orbit as non-functioning

[61] NPRM at ¶ 31.

[62] *Id*.

[63] *See* NPRM at n. 89; 2004 Orbital Debris Order at ¶ 61; U.S. Government Orbital Debris Standard Practices 4-1, *available at* https://www.orbitaldebris.jsc.nasa.gov/library/usg_od_standard_practices.pdf.

[64] *See* European Space Agency, ESA's Annual Space Environment Report at 11 (May 18, 2018), https://www.sdo.esoc.esa.int/environment_report/Space_Environment_Report_latest.pdf.

space debris longer by an order of magnitude than its useful mission life. OneWeb and other operators have argued that responsible orbital stewardship requires a much more rapid disposal of spacecraft upon mission completion.[65]

Second, the general reliance on the 650 km altitude as an inflection point for orbital lifetimes is similarly misguided.[66] The NPRM correctly identifies that the natural orbital lifetime of satellites is heavily influenced by factors such as satellite size and solar activity.[67] Furthermore, orbital lifetime is a continuous function of altitude: it is not accurate to specify 650 km as an inflection point, above which satellites will "remain in orbit for significantly longer periods of time" than a satellite just below 650 km.[68]

The NPRM's proposal to require NGSO applicants to "specify" or provide a "rationale" behind selection of an orbit above 650 km is therefore based on two flawed premises. Instead, a shorter de-orbit period tied to mission duration should be adopted. OneWeb supports the NPRM's proposal to require satellite post-mission lifetimes not to exceed proposed mission lifetimes by more than a factor of two ("De-Orbit Time Requirement"), but suggests this be capped at a maximum of five years.[69]

Consider a satellite launched as an early iteration of an NGSO constellation with an intended mission life of four years. Without a requirement linking de-orbit timeframe to mission duration, the satellite could remain in-orbit for 25 years, or more than six times as long as its

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[65] Orbital Debris Op-Ed.

[66] NPRM at ¶ 31.

[67] *Id*. at n. 88.

[68] *Id*. at ¶ 31.

[69] *Id*. at ¶ 32.

operational mission. Under the proposed De-Orbit Time Requirement, that same satellite would only have four years to successfully de-orbit following the completion of its operational mission. Such a requirement would also discourage the use of LEO as a testing ground for underdeveloped or unproven satellite designs by forcing operators to contend with the effects of intentionally shorter orbital lifetimes.

However, this well-intended proposal should not be entangled with the orbit selection process, as proposed in the NPRM.[70] Forcing operators to select orbits based solely on expected mission lifetimes is unnecessarily restrictive and ignores the role of technological innovation in reducing post-mission lifetimes. Instead, OneWeb proposes coupling the De-Orbit Time Requirement with a de-orbit reliability requirement of 95%, which could be reached either through orbital selection or active de-orbiting measures. OneWeb's proposal would allow NGSO operators to meet the De-Orbit Time Requirement not only through passive means such as orbit selection, but also through active de-orbiting measures, which could encourage the development of such measures. OneWeb's proposal would also allow NGSO operators with sufficient de-orbit capabilities to deploy in the altitude best suited for mission requirements, without being forced to select an orbit based on mission length.[71]

In summary, OneWeb supports the proposal to link mission lifetime with de-orbit lifetime. However, the NPRM's proposal to allow de-orbit time to dictate the orbital selection of NGSO

[70] *See id*. at ¶ 32.

[71] OneWeb also believes the Commission's proposal to require disclosure based on orbital debris concentration in certain orbits is ineffective. Various sources of LNT Debris likely spans most of LEO, so most if not all LEO operators could be impacted. The specification of an orbit selection rationale is unlikely to materially reduce the risk of in-orbit, debris-related collisions. *See id*. at ¶ 33.

satellites is harmful to the optimal orbital selection for mission purposes, and the Responsible Agency would be better served by allowing operators to meet any de-orbiting time requirement through both active and passive measures.

B. The Proposal to Require a "Staging" Orbit Below 650 km Is Misguided

The NPRM's proposal to require all satellites that will operate at an altitude of 650 km or above to first enter an orbit below 650 km and only raise to mission orbit upon demonstration of full functionality is overly restrictive.[72] OneWeb recognizes the Commission's intent to "ensure that if satellites are found to be non-functional immediately following deployment, such that they will be unable to perform any maneuvers, they will re-enter the atmosphere within 25 years."[73] However, attempting to achieve this goal via a mandated "staging orbit" could critically undermine the business plans and mission profiles of a variety of satellite systems, and it is an inefficient way to address the potential problems caused by failed spacecraft.

The NPRM also seeks comment on a proposal to "require that applicants for large constellations test a certain number of satellites in a lower orbit for a certain number of years before deploying larger numbers, in order to resolve any unforeseen flaws in the design that could result in generation of debris."[74] The testing proposal is impractical and should be rejected for two related reasons. *First*, it fails to take into account certain commercial realities. The launch and operation of large NGSO FSS constellations is a highly capital-intensive undertaking. For instance, OneWeb recently raised an additional $1.25 billion in capital and has raised well over $3

[72] *Id*. at ¶ 48.

[73] *Id*.

[74] *Id*.

billion to date.[75] For commercial ventures of this size, scale, and ambition, multi-year "testing" period requirements would significantly impact the ability of companies to successfully operate an NGSO FSS constellation, as the negative impacts to revenue generation and infrastructure deployment time could be damaging. An NGSO "on-orbit testing" requirement runs the risk of unnecessarily stifling the momentum of NGSO FSS systems precisely at the moment such systems are poised to unlock much-needed competition and innovation in the market for next-generation connectivity services.

Second, the adoption of a multi-year "on-orbit testing" requirement may be inconsistent with the Commission's milestone requirements. Currently, NGSO FSS operators are required to launch and operate at least 50 percent of the maximum number of authorized space stations six years after the Commission's license grant.[76] The Commission has sound policy reasons for such a requirement: the milestone obligation prevents spectrum warehousing and "discourage[s] applicants from seeking authorizations for oversized, unrealistic constellations."[77] Adoption of the "staging ground" proposal, however, could delay spectrum utilization and unnecessarily complicate potential milestone compliance for NGSO FSS licensees. Instead, OneWeb proposes that satellites of a new design should be launched in limited numbers, and if a systemic problem is experienced, subsequent launches should be postponed until a resolution is identified and

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[75] Ashlee Vance, *OneWeb Raises Fresh $1.25 Billion for Internet System From Space*, BLOOMBERG (Mar. 18, 2019), https://www.bloomberg.com/news/articles/2019-03-18/oneweb-raises-fresh-1-25-billion-for-internet-system-from-space.

[76] *See* 47 C.F.R. § 25.164(b)(1).

[77] *See Update to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters*, Report and Order and Further Notice of Proposed Rulemaking, 32 FCC Rcd 7809, 7822 ¶ 66 (2017).

implemented on subsequent satellites. At a minimum, the Commission should clarify what impact this proposal could have on operators' compliance with the Commission's NGSO milestone rule.[78]

C. Requiring Automatic De-Orbit of LEO Spacecraft Upon a Failure Event Is Unnecessary and May Actually Increase Risk

The NPRM proposes to require NGSO applicants to ensure that spacecraft disposal will be automatically initiated in the event of a loss of power or contact based on a rationale that "this requirement would help ensure that spacecraft failures do not result in a concentration of debris in the LEO region."[79] While OneWeb appreciates the Commission's focus on preventing debris in LEO, adoption of this proposal would not serve that purpose and should be rejected.

In practice, the effect of the proposed rule could perversely *increase* the chance of significant orbital debris generation from a satellite in an unknown state. In evaluating the potential adoption of an automatic de-orbit rule, consider the scenario of a satellite that has "lost contact." A satellite with no contact is a spacecraft over which an operator has no control and likely no monitoring capability, which could result in highly unpredictable and uncontrollable behaviors and trajectories that could traverse the orbits of many other critical assets. In addition, it is quite possible for such a satellite to be unable to properly execute its pre-planned de-orbit operation. A malfunctioning satellite executing a faulty de-orbiting maneuver would be on an unpredictable trajectory, which may be far more risky than if the failed satellite were simply to remain in a more stable, predictable orbit. As such, the proposal to require automatic de-orbiting in the event of a satellite's loss of active control should be rejected.

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[78] For example, would satellites launched for "test" purposes qualify towards the number of satellites needed to satisfy the NGSO milestone requirement? *See* 47 C.F.R. § 25.164(a).

[79] NPRM at ¶ 49.

D. De-Orbit Requirements Should Not Prescribe a Particular Methodology for the Removal of LEO and MEO Spacecraft

The NPRM asks whether disposal of spacecraft in the LEO region must be accomplished by either atmospheric re-entry or direct retrieval.[80] The NPRM also asks about the viability of direct retrieval technology, as well as the practicality of disposing NGSO satellites in orbits above LEO.[81] Advances in de-orbit technology should be encouraged, but it would be premature to specify a particular methodology for de-orbiting LEO and MEO spacecraft at this time.

OneWeb supports the adoption of a requirement that disposal of spacecraft from LEO result in the successful de-orbiting of the spacecraft as long as the Responsible Agency refrains from dictating a specific de-orbit methodology. Active retrieval and controlled de-orbit capabilities are both legitimate options for removing LEO spacecraft from orbit at mission completion, and NGSO FSS operators should be able to rely on either mechanism. OneWeb remains optimistic about the continued development of active debris removal ("ADR") technologies and envisions ADR as a beneficial component of maintaining a safe orbital environment in the future. In fact, OneWeb is including a grappling fixture and fiducials on every OneWeb NGSO spacecraft to facilitate capture and encourage the standardization of interfaces.[82]

E. Post-Mission Reliability Measures Should Include a .95 Probability of Disposal Success for Large Constellations

The NPRM appropriately recognizes the ramifications of non-functioning spacecraft are "magnified" in a crowded LEO operating environment where failed spacecraft can remain in orbit

[80] *Id*. at ¶ 52.

[81] *Id*. at ¶¶ 53-55.

[82] Senate Testimony at 5.

for many years.[83] Although the Commission's rules currently require licensees to state their post-mission disposal plan, OneWeb believes more robust de-orbit and disposal rules are necessary to account for the exponential increase in spacecraft anticipated to be deployed in LEO in the coming years.[84] Furthermore, any failure or anomaly of propulsion systems on demonstration spacecraft should be reported to and reviewed by the Responsible Agency.

OneWeb supports the adoption of a post-mission reliability measure that requires satellites in large NGSO FSS constellations to meet a .95 probability of disposal success standard.[85] For missions involving small numbers of satellites, OneWeb agrees with the Commission that the NASA Standard is a reasonable de-orbit reliability metric.[86] For large constellations, however, OneWeb encourages the introduction of a more rigorous standard than the NASA Standard discussed in the NPRM.[87] In particular, NASA has noted, in response to SpaceX's initial constellation application, that the .90 threshold "may not be sufficient for a large constellation."[88] Due to the complicating factors that large constellations present, OneWeb supports the adoption of a .95 probability of disposal success standard.

For large constellations, OneWeb agrees "the reliability of the design and fabrication of the spacecraft and the reliability that the spacecraft can accomplish the post-mission disposal are

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[83] NPRM at ¶ 44.

[84] *See* 47 C.F.R. § 25.114(d)(14)(iv).

[85] The NPRM itself anticipates a more stringent requirement for large constellations. *See* NPRM at ¶ 46.

[86] *Id*.

[87] *Id*.

[88] NASA Letter at 1.

of particular interest from the perspective of keeping the orbital environment safe."[89] OneWeb, for instance, has designed the deorbiting subsystems on its satellites to be "the highest reliability functions on the entire spacecraft—even above that of the revenue-generating payload."[90] In a LEO environment potentially populated by thousands of satellites, a heightened disposal reliability requirement will help to ensure the collective safety of NGSO FSS constellations.

VII. THE COMMISSION PROPERLY RECOGNIZES APPROPRIATE LIMITS ON ITS AUTHORITY OVER MARKET ACCESS APPLICANTS

The NPRM's proposals to potentially impose indemnification or insurance requirements on non-U.S. licensees should not be adopted because the proposals are anti-competitive and rest on a questionable jurisdictional basis. In addition, continuation of the Commission's policy to allow a direct and effective orbital debris regulation showing is consistent with the Commission's long-standing approach to meeting U.S. commitments to the World Trade Organization and facilitating a competitive and thriving satellite industry in the United States.

A. No Indemnification or Insurance Obligations Should Be Required of Market Access Applicants Who Retain Indemnification Obligations to Other Nations

The NPRM seeks comment on whether Commission space station licensees should be required to indemnify the U.S. "against any costs associated with a claim brought against the United States related to the authorized facilities."[91] The NPRM also asks whether there are any circumstances in which non-U.S. licensees should also have indemnification obligations to the

[89] *Id*. at 2.

[90] OneWeb De-Orbit Article.

[91] NPRM at ¶ 78.

Commission.[92] In addition, the NPRM asks for comment on whether insurance obligations should be imposed on satellite operators.[93]

For non-U.S. licensees who retain indemnification or similar obligations to other nations, requirement of such obligations from the Responsible Agency would be unnecessary and place such licensees at a competitive disadvantage. In such a capital-intensive industry, forcing non-U.S. licensees with indemnification or insurance requirements to other nations to effectively double (relative to U.S. licensees and assuming similar levels of financial obligations among nations) the capital allocated to these requirements. Making additional financial commitments to the Responsible Agency would unjustly penalize non-U.S. licensees. The anti-competitive impacts of such a requirement may also violate the U.S. market-opening commitments made in the World Trade Organization ("WTO") Agreement on Basic Telecommunications Services and first implemented in the DISCO II Order by placing non-U.S. licensed NGSO operators at a competitive disadvantage.[94]

The NPRM seeks comment on whether such a requirement could "encourage industry to be licensed by or launch from the United States."[95] The NPRM does not, however, ask the degree to which imposition of such requirements could discourage non-U.S. licensees from seeking market access in the United States. U.S. consumers are well-positioned to benefit from the new frontier of connectivity services offered by NGSO FSS systems and other innovative satellite-

[92] *Id*. at ¶ 79.

[93] *Id*. at ¶ 80.

[94] *See Amendment of the Commission's Regulatory Policies to Allow Non-U.S.-Licensed Space Stations to Provide Domestic and International Satellite Service in the United States*, Report and Order, 12 FCC Rcd 24094 (2007) ("DISCO II Order").

[95] NPRM at ¶ 80.

based providers. Indirectly punishing U.S. consumers by making the United States a less attractive place to invest substantial capital, create hundreds of high-paying jobs, and provide cutting edge connectivity to the otherwise unconnected[96] is surely not an outcome that is consistent with the stated intention of the Administration and the Commission to maintain U.S. leadership in space.[97]

Any attempt to impose indemnification or insurance obligations on non-U.S. licensed market access applicants would also be based on shaky jurisdictional grounds. As both the 2004 Orbital Debris Order and the NPRM detail, the Liability Convention specifies that "launching states" can be held liable for any costs or claims caused by satellite operators.[98] The Liability Convention defines "launching state" as a state which launches or procures the launching of a space object or a state from whose territory or facility a space object is launched.[99] For a satellite licensed and launched outside the United States, merely granting U.S. market access is unlikely to result in the United States incurring any "launching state" liability. Therefore, the imposition of indemnification/insurance requirements lacks a sound jurisdictional basis, as non-U.S. licensees

[96] For example, OneWeb has nearly concluded construction of a satellite production facility in Florida that will bring significant capital investment and jobs to the area. *See* Caleb Henry, *What Airbus learned from building satellites with OneWeb*, SPACENEWS (Mar. 19, 2019), https://spacenews.com/what-airbus-learned-from-building-satellites-with-oneweb/.

[97] *See, e.g.* Space Policy Directive-3, National Space Traffic Management Policy, Presidential Memorandum (June 18, 2018), https://www.whitehouse.gov/presidential-actions/space-policy-directive-3-national-space-traffic-managementpolicy/; Jeffrey Hill, *FCC Chairman Wants to Cultivate Innovation in Space*, VIASATELLITE (Feb. 2019), http://interactive.satellitetoday.com/via/february-2019/fcc-chairman-wants-to-cultivate-innovation-in-space/.

[98] *See* NPRM at n. 183; 2004 Orbital Debris Order at ¶ 109-110; Convention on International Liability for Damage Caused by Space Objects of 1972, Articles I and II ("Liability Convention").

[99] *Id.*

would be forced to financially account for claims that likely could not be successfully prosecuted against the U.S.

In fact, imposing indemnification/insurance requirements on non-U.S. licensees who already retain similar obligations to other nations could have the perverse effect of *increasing* claims against the United States. Claimants under the Liability Convention are likely to bring claims against any nation that could be considered a launching state. For non-U.S. licensees with U.S. market access, as noted above, there would likely be too much attenuation for a claimant to reasonably define the United States as a launching state.

However, if the Responsible Agency were to require non-U.S. licensees with market access to have indemnification/insurance requirements, claimants may use the financial commitments as evidence of the United States' "launching state" status, irrespective of whether the United States is in fact a "launching state." Such a rule could unintentionally increase the United States' exposure to potential liability under the Liability Convention, which is not an ideal outcome from this proceeding. The proposal to require non-U.S. licensees to undertake indemnification and insurance requirements as a condition of U.S. market access unfairly prejudices non-U.S. licensees, is anticompetitive, and is based on dubious jurisdictional claims.

B. The Commission Should Continue to Allow Market Access Applicants to Satisfy Applicable Orbital Debris Rules By Demonstrating Direct and Effective Oversight By a Foreign Licensing Authority

The NPRM proposes that non-U.S.-licensed satellites "may continue to satisfy the disclosure requirement by showing that the satellite system's debris mitigation plans are subject to direct and effective regulatory oversight by the satellite system's national licensing authority."[100] OneWeb fully supports the NPRM's proposal to allow market access applicants to satisfy

[100] NPRM at ¶ 87.

applicable orbital debris rules by showing direct and effective regulatory oversight by a foreign licensing authority.[101] Continuation of the Commission's disclosure requirement policy would be consistent with the Commission's approach to meeting its market-opening commitments made in the WTO Agreement on Basic Telecommunications Services and first implemented in the DISCO II Order.[102]

In 2004, the Commission properly concluded the disclosure requirement could be satisfied by non-U.S. licensed systems through a direct and effective regulatory oversight showing.[103] The Commission has since effectively relied on this regime to grant U.S. market access to a number of foreign-licensed NGSO FSS constellations, including several operators granted U.S. market access in the current processing rounds.[104] Allowing a direct and effective regulation showing to satisfy the disclosure requirements is consistent with long-standing Commission policy and the United States' legally binding and enforceable treaty-based commitments.[105]

The Commission's policy of allowing such a showing benefits all satellite licensees, both U.S. and foreign, by enabling the Commission to conserve administrative resources and avoid the

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[101] *Id.*

[102] *See generally* DISCO II Order.

[103] 2004 Orbital Debris Order at ¶ 95.

[104] *See WorldVu Satellites Limited, Petition for a Declaratory Ruling Granting Access to the U.S. Market for the OneWeb NGSO FSS System*, Order and Declaratory Ruling, 32 FCC Rcd 5366 (2017); *Request for Modification of U.S. Market Access for O3b Limited's Non-Geostationary Satellite Orbit System in the Fixed-Satellite Service and in the Mobile-Satellite Service*, IBFS File Nos. SAT-MOD-20160624-00060, SAT-AMD-20161115-00116, SAT-AMD-20170301-00026, and SAT-AMD-20171109-00154, Order and Declaratory Ruling, 33 FCC Rcd 5508 (2018).

[105] *See, e.g. Rules and Policies on Foreign Participation in the U.S. Telecommunications Market*, Report and Order on Reconsideration, 12 FCC Rcd 23891, 23896 ¶ 9 (1997) (instituting an open entry standard for WTO Member country applicants for U.S. market access "in light of the market-opening commitments in the WTO Basic Telecom Agreement").

wasteful efforts of duplicating actions already taken by another regulatory body. The direct and effective regulation showing also creates efficiencies on the side of the satellite system operator. Many satellite service providers need to obtain market access in dozens if not hundreds of jurisdictions across the globe. The Commission's policy of allowing a showing of direct and effective regulation streamlines the U.S. market access review process and allows satellite operators to expeditiously provide innovative, competitive service offerings to consumers.

This framework has functioned well over the last fifteen years and it has encouraged numerous foreign satellite systems to introduce innovative services, facilitate competition, create jobs, and invest capital in the United States. OneWeb supports the continuation of the Commission's policy of allowing a market access applicant to satisfy the disclosure requirement by showing that the satellite system's debris mitigation plans are subject to the direct and effective regulatory oversight of the applicant's national licensing authority.

VIII. CONCLUSION

OneWeb commends the Commission for initiating this important proceeding and recognizing that the current regulatory framework must be updated in order to safeguard the orbital environment. OneWeb looks forward to shaping a regulatory framework that will facilitate the sustainable development of space for the next generation.

Respectfully submitted,

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